

BiOWiSH® Crop Liquid

Evaluation of BiOWiSH® Crop Liquid on Rice Production in Vietnam



Executive Summary

BiOWiSH Technologies engaged Vietnam Academy of Agricultural Sciences as a third-party contract research organization (CRO) to conduct a study to determine the effects of BiOWiSH® Crop Liquid coated onto urea to create an Enhanced Efficiency Fertilizer (EEF) for rice production as part of standard and reduced fertility programs, compared to the Control.

The trial compared four treatments:

- Control, Standard Fertility Program
- Control + BiOWiSH® Crop Liquid
- 10% N Optimized Fertility Program + BiOWiSH® Crop Liquid
- 20% N Optimized Fertility Program + BiOWiSH® Crop Liquid

Vietnam has become one of the world's leading agricultural producers and exporters. Agriculture represents over 12% of the GDP for Vietnam. Rice is the largest crop grown in the country with over 40 million metric tons, making Vietnam one of the leading rice producers in the world. Acreage expansion for rice production has led to crops being grown in coastal areas with stress from higher saline content in the soil from tidal inundation and ground water.

BiOWiSH® Crop Liquid



- Optimizes yield potential by improved nutrient uptake
- Increases nutrient use efficiency and supports nutrient uptake
- Optimizes soil conditions for greater root mass
- Improves soil conditions for increased plant vigor
- Enhances beneficial microbes in the rhizosphere

Available Size

- 264 gal/1000 L

Background

About BiOWiSH Technologies

Headquartered in Cincinnati, Ohio, BiOWiSH Technologies, Inc. is a global provider of biotechnology solutions. As a leader in the agricultural market, we help farmers increase crop production sustainably, safely, and cost effectively. Our revolutionary BiOWiSH® Crop Liquid is a blend of proprietary microbial cultures that can be coated onto dry fertilizer or mixed with liquid fertilizers to create an enhanced efficiency fertilizer. BiOWiSH® endophytic *Bacillus* deliver soil nutrients to crops through the rhizophagy cycle creating a symbiotic relationship between the plant and soil microbes. This helps farmers achieve consistent results across a broad range of operating conditions, climates, and environments. By unifying nature and science, BiOWiSH reinvents the way food is grown. For more information, visit biowishtech.com.

About Vietnam Academy of Agricultural Sciences

The Vietnam Academy of Agricultural Sciences provides a comprehensive vision, strategic direction and oversight of agriculture Research and Development programs. It conducts basic and applied research to foster the transfer of new technologies in Vietnam.

Objectives

The primary objective of this trial was to evaluate the performance of BiOWiSH® Crop Liquid coated onto urea to create an Enhanced Efficiency Fertilizer (EEF) for rice as part of standard and N Optimized (reduced rate) Fertility Programs compared to the Control.

Implementation Program

This trial was carried out by using a randomized complete block design (RCBD) with four treatments. Each treatment is arranged in 56 m² (7 m x 8 m) plots with six replications. The variety used was MO18 and was planted during the first week of February. In addition to the applied urea EEF, an additional application of 40 kg (88 lbs) of P₂O₅ (enhanced phosphate) was applied at one day before sowing and 30 kg (66 lbs) of K₂O (KCl) was applied at the rooting stage (nine days after sowing). The rice seeds were soaked for 24 hours, cleaned, and allowed to incubate for thirty-six hours prior to planting. Seeding was accomplished using a drum seeder at a density of 100 kg/ha (89 lbs/acre). The urea was applied over three growth stages: 30% at rooting, 40% tillering, and 30% booting (9, 20, and 46 days after sowing respectively).

Weed management was accomplished by a herbicide application one day before planting and remaining weeds were removed from the plot manually. Integrated pest management and pesticides were used when deemed necessary by local recommendations.

Table 1. Fertilizer, Treatments, and Application Timing

Treatment	Application Rate kg/ha [lbs/acre]	Application Phase [% of Total]
Control, Standard Urea Fertility Program	217 [194]	Rooting, Tillering, Booting [30, 40, 30]
Control + BiOWiSH® Crop Liquid	217 [194]	Rooting, Tillering, Booting [30, 40, 30]
10% N Optimized Fertility Program + BiOWiSH® Crop Liquid	195 [174]	Rooting, Tillering, Booting [30, 40, 30]
20% N Optimized Fertility Program + BiOWiSH® Crop Liquid	174 [155]	Rooting, Tillering, Booting [30, 40, 30]

*BiOWiSH® Crop Liquid used at manufacturer's recommended rate.

Soil Analysis

Soil sampling was conducted prior to sowing to determine pH (H₂O and KCl), total and available N, P, K, CEC, dissolved B, exchangeable cations Ca, Mg, exchangeable Al and Fe. Salinity at the site was not considered "High", defined as an EC of 5-6 dS/m, with the average EC being 1.09 dS/m.

Table 2. Soil Analysis Table

pH _{H₂O}	pH _{KCl}	EC (dS/m)	OC (%)	N (ppm)	P (ppm)	K (ppm)	Ca (meq/ 100g)	Mg (meq/ 100g)	Al ³⁺ (meq/ 100g)	Fe ₂ O ₃ (ppm)	CEC (meq/ 100g)	B (ppm)
5.29	4.48	1.09	5.57	11.60	33.30	255.26	5.21	7.68	0.03	8.52	16.58	0.79

Results

Plant Height

Plant heights and tiller counts were collected from 30 random plants per treatment at the growth stages of seedling, tillering, booting, and flowering. Yield and yield components (grain yield, panicles/m², filled grain/panicle, filled grain weight and 1000-grain weight) were collected at harvest. Actual yield was calculated by weighing the total grain collected from a 5 m² sample with actual moisture, then converting the weight into kg/ha and corrected to 14% moisture.

Table 3. Plant Height Analysis Table

Treatment	Plant Height 20 DAS cm [in]	Plant Height 35 DAS cm [in]	Plant Height 45 DAS cm [in]	Plant Height 70 DAS cm [in]
Control, Standard Urea Fertility Program	27.4 [10.8]	52.0 [20.5]	62.1 [24.4]	99.9 [39.3]
Control + BiOWiSH® Crop Liquid	27.8 [10.9]	51.7 [20.4]	62.1 [24.4]	100.0 [39.4]
10% N Optimized Fertility Program + BiOWiSH® Crop Liquid	27.4 [10.8]	52.1 [20.5]	62.3 [24.5]	100.0 [39.4]
20% N Optimized Fertility Program + BiOWiSH® Crop Liquid	27.6 [10.9]	51.5 [20.3]	62.5 [24.6]	101.0 [39.8]

*BiOWiSH® Crop Liquid used at manufacturer's recommended rate.

**DAS: Days After Sowing

Tiller Count

Statistically significant differences in tiller counts were recorded at seedling stage (20 DAS) for Control + BiOWiSH® and the 10% N Optimized Fertility Program + BiOWiSH®. There were numeric increases in tiller counts for those two treatments at tillering (35 DAS), booting, and flowering as well, indicating improved soil conditions for increased plant vigor.

Table 4. Tiller Count Analysis Table

Treatment	Tiller Count 20 DAS number/m ² [number/sq ft]	Tiller Count 35 DAS number/m ² [number/sq ft]	Tiller Count 45 DAS number/m ² [number/sq ft]	Tiller Count 70 DAS number/m ² [number/sq ft]
Control, Standard Urea Fertility Program	629 b [58.4]	984 [91.4]	62.1 [24.4]	99.9 [39.3]
Control + BiOWiSH® Crop Liquid	677 a [62.9]	999 [92.8]	62.1 [24.4]	100 [39.4]
10% N Optimized Fertility Program + BiOWiSH® Crop Liquid	677 a [62.9]	1050 [97.5]	62.3 [24.5]	100 [39.4]
20% N Optimized Fertility Program + BiOWiSH® Crop Liquid	655 ab [60.9]	946 [87.9]	62.5 [24.6]	101 [39.8]

*Unique letters indicate statistically significant differences at alpha = 0.05

**DAS: Days After Sowing

Panicle Count

Table 5. Panicle Count Analysis Table

Treatment	Panicle Count number/m ² [number/sq ft]	1000-Grain Weight (14%) grams [ounces]	Filled Grain number/panicle	Filled Grain Rate %
Control, Standard Urea Fertility Program	397 b [36.9]	23.2 [0.82]	58 b	62.6 c
Control + BiOWiSH® Crop Liquid	421 a [39.1]	23.5 [0.83]	66 a	68.6 ab
10% N Optimized Fertility Program + BiOWiSH® Crop Liquid	427 a [39.7]	23.5 [0.83]	67 a	71.6 a
20% N Optimized Fertility Program + BiOWiSH® Crop Liquid	400 b [37.2]	23.2 [0.82]	61 b	67.0 b

*Unique letters indicate statistically significant differences at alpha = 0.05

Table 6. Yield and Net Income Table

Treatment	Yield MT/ha [bu/acre]	Yield Increase MT/ha [bu/acre]	Yield Increase %	Net Income USD/ha [USD/acre]	Profit Change USD/ha [USD/acre]
Control, Standard Urea Fertility Program	4.77 [95]	-	-	567 [229]	-
Control + BiOWiSH® Crop Liquid	5.15 [102]	0.38 [7]	8.0	637 [258]	70 [28]
10% N Optimized Fertility Program + BiOWiSH® Crop Liquid	5.22 [104]	0.45 [9]	9.4	669 [271]	102 [41]
20% N Optimized Fertility Program + BiOWiSH® Crop Liquid	4.87 [97]	0.10 [2]	2.1	617 [250]	50 [20]

*Calculations for conversions between imperial and metric units are based on the original source data; slight rounding differences may occur within reported publication values.

**Net income is the crop value minus the fertility program cost. It does not account for non-fertility expenses.

***Profit change is the difference between net income of the respective program and the Control.

Conclusion

BiOWiSH® endophytic *Bacillus* deliver soil nutrients to crops through the rhizophagy cycle creating a symbiotic relationship between the plant and soil microbes. This enables optimized yield potential by improved nutrient uptake. This increased profitability of the rice crop in this study by \$70 USD/ha (\$28 USD/acre) for the Control + BiOWiSH® treatment, compared to the Control. In the N Optimized Fertility Programs, the BiOWiSH® EEF increased profitability by \$102 USD/ha (\$41 USD/acre) and \$50 USD/ha (\$20 USD/acre) for the 10% and 20% N Optimized treatments, respectively. This provides growers with options for how to manage their crop while increasing their potential for economic return.



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